

# Productivity and Policy Reform in Australia

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Canada and Australia have remarkably similar living standards and productivity levels — at least on paper. The data suggest only about \$100 difference in annual GDP per capita and only a few cents difference in GDP per hour worked.<sup>1</sup>

But the comparisons have not always been quite so close. In 1950, Canada was ahead on average income and labour productivity and its rate of improvement in both measures was stronger than Australia's for at least the following two decades. As recently as 1990, Canada was 17 per cent higher than Australia on GDP per capita and 15 per cent higher on GDP per hour worked.

Australia caught up with Canada in the 1990s. Australia's growth in productivity and GDP has been very strong by OECD standards since the early 1990s, even in the midst of the Asian financial crisis in 1997 and a global downturn in 2001.

This article examines Australia's productivity performance and focuses on the reasons for a marked improvement in the 1990s. The explanations are largely found in a change in government policy strategy that has fostered a transition to a more competitive, open, flexible, innovative and resilient economy.

## The Long Road to Policy Action

Australia's rate of productivity growth was comparatively weak over most of the 20th century. At the beginning of the century, Australia had the highest level of labour productivity in the world (Maddison 2001), reflecting the combination of a relative abundance of natural resources and a relatively small population. Governments subsequently traded this high productivity position for nation building as, with widespread popular support, they encouraged population growth, diversification of the economic base and redistribution of income through a set of policies that had the (perhaps unintentional) consequence of holding back growth in productivity and living standards.

Australia still enjoyed a relatively high ranking in 1950. Australia's GDP per hour had slipped to 81 per cent of the level of the productivity leader — the United States — but it still ranked 4th among a group of 22 developed or high-income countries (Table 1).

The postwar era was a period in which high-income countries tended to catch up on the leader, bringing closer convergence in productivity levels across countries. European countries, Japan and Korea were the strong movers.

**Table 1**  
**International Ranking of United States, Canada and Australia on Average Income, Labour Productivity and Labour Utilization<sup>1</sup>**

	1950		1973		1990		2001	
	Rank	% US	Rank	% US	Rank	% US	Rank	% US
<b>GDP per capita (1996 \$US)<sup>2</sup></b>								
United States	2	100	2	100	1	100	1	100
Canada	4	80	4	87	3	86	6	78
Australia	5	78	9	74	15	74	7	78
<b>GDP per hour worked 1996 \$US<sup>2</sup></b>								
United States	1	100	2	100	5	100	5	100
Canada	2	95	4	91	9	88	13	83
Australia	4	81	10	74	15	77	14	83
<b>Labour utilization Annual hours worked per capita<sup>3</sup></b>								
United States	14	100	11	100	4	100	2	100
Canada	20	86	18	96	5	97	6	94
Australia	16	96	7	104	6	96	5	94

1 Rankings are among 22 of the 24 OECD pre-1994 membership countries.

2 At purchasing power parity.

3 Labour utilization explains the gap between average income and labour productivity. GDP per capita is equal to GDP per hour worked multiplied by hours worked per capita.

Data source: University of Groningen and The Conference Board, GGDC Total Economy Database, 2002; <http://www.eco.rug.nl/ggdc>, accessed 7 March 2002.

They showed faster productivity growth not only during the post-war “golden age” but also during the post-1973 slowdown (Table 2<sup>2</sup>). Some countries even overtook the United States, which slipped in ranking to 5th by 1990.

Australia did not participate in this “convergence club.” Its productivity growth was relatively weak, especially during the golden-age productivity boom (Table 2). Many countries overtook Australia and by 1990, its ranking had dropped to 15th.

A string of economic and policy reviews in the 1960s, 1970s and 1980s attributed Australia’s relatively poor productivity performance to highly regulated product, capital and labour markets and the inefficient provision of economic infrastructure (including electricity, gas, water, communications, and transport). Government-owned enterprises dominated economic infrastructure and their (poor) performance was determined in large part by political overlays on their operations.

Australia’s relatively poor productivity growth also meant relatively poor growth in average income. Growth in average income is also influenced by labour utilization — average hours worked in the population at large — but Australia’s growth in labour utilization has been above the OECD average (Table 2). Australia’s per capita GDP grew at about two-thirds of the OECD rate during the boom 1950-73 period and was still below the OECD rate during the post-1973 slowdown (Table 2). Australia’s average income ranking slipped from 5th in 1950 to 15th in 1990 (Table 1).

Even though the reviews reported that Australia’s growth in living standards was below potential, politically, the rate of progress up to the second half of the 1970s was considered to be sufficient. There was also a fairly widespread belief at the end of the 1970s that there was another commodities boom just around the corner to reinvigorate income growth.

However, a sense of crisis emerged in the 1980s as pessimism about the outlook for the terms of trade took hold, competition from Asian manufactures strengthened and Australia slipped further in the international league table of per capita incomes. Australia was being overtaken not only by OECD countries, but by non-OECD countries as well.

The growing sense of crisis galvanised community support for governments to take policy action to address structural weaknesses in the economy and to raise productivity growth. The approach was not to attempt to raise productivity growth via a “targeted” or industry-specific strategy. Rather, the approach was largely to release the shackles that had previously restricted productivity growth and to pursue social objectives through more targeted and less-distortionary instruments.

Policy reforms were introduced progressively from the mid-1980s and continued through the 1990s. Reforms have included: deregulation of access to finance; floating the currency; marked reductions in barriers to trade and foreign direct investment; commercialization (and some privatization) of government business enterprises; strengthening domestic competition; and enabling greater labour market flexibility.<sup>3</sup> The hallmarks of macro policy have become to rein in budget deficits and to vest the central bank with the clear responsibility to adjust monetary policy settings to target inflation.

### The Productivity Surge in the 1990s

Australia’s productivity growth surged in the 1990s. There were nine years of continuous increase from the trough of the recession in 1990-91 to a productivity peak in 1999-2000.<sup>4</sup> Whilst recovery from the recession could be expected to have played a part in the productivity uplift in the early part of the 1990s, there was

**Table 2**  
**Average Annual Growth in Average Income, Labour Productivity and Labour Utilization**  
(per cent)

	1950-73	1973-90	1990-2001
<b>GDP per capita</b>			
United States	2.4	1.9	2.0
Canada	2.7	1.8	1.2
Australia	2.3	1.7	2.5
Europe <sup>1</sup>	3.8	1.7	1.1
OECD	3.6	2.0	1.5
<b>GDP per hour worked</b>			
United States	3.0	1.3	1.6
Canada	2.8	1.1	1.1
Australia	2.5	1.5	2.3
Europe <sup>1</sup>	4.6	2.4	1.7
OECD	4.0	2.0	1.8
<b>Labour utilization (Annual hours worked per capita)<sup>2</sup></b>			
United States	-0.6	0.7	0.4
Canada	-0.1	0.8	0.1
Australia	-0.2	0.2	0.2
Europe <sup>1</sup>	-0.8	-0.6	-0.6
OECD	-0.5	0.0	-0.3

1 Includes the former East Germany from 1990.

2 Growth in labour utilization explains the difference between growth in GDP per capita and growth in hours worked per capita.

Data source: Same as Table 1.

clearly more than a cyclical rebound at work to sustain growth over such a long period.

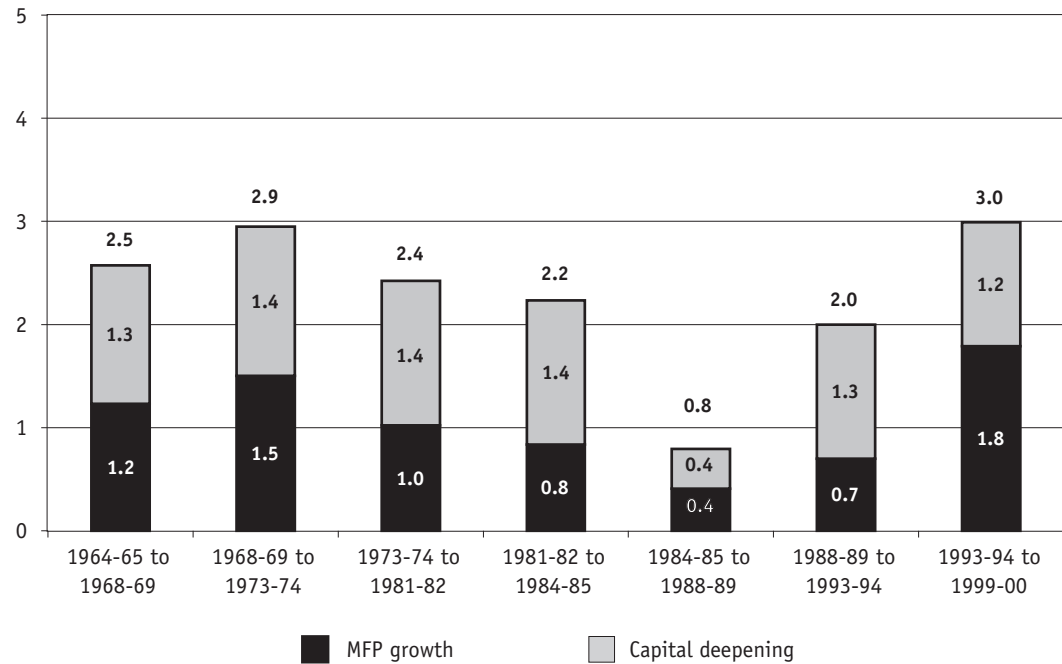
Chart 1 shows the rates of labour productivity growth over productivity cycles in the market sector of the Australian economy.<sup>5</sup> Measurement over productivity cycles — from productivity peak to productivity peak — greatly reduces the spurious influence of the business cycle on productivity estimates.

The 3.0 per cent annual average labour productivity growth reached in the 1990s cycle is a record high. It meant that the underlying rate of productivity growth accelerated a full percentage point, compared with the previous cycle.

Improved multifactor productivity (MFP), or efficiency of resource use, was the major reason behind the productivity surge. MFP growth of 1.8 per cent a year in the 1990s cycle was also a record high and accounted for 60 per cent of the 1990s

**Chart 1**  
**Growth in Labour Productivity Over Productivity Cycles<sup>1</sup> and Contributions from Capital Deepening and Multifactor Productivity, 1964-65 to 1999-2000**

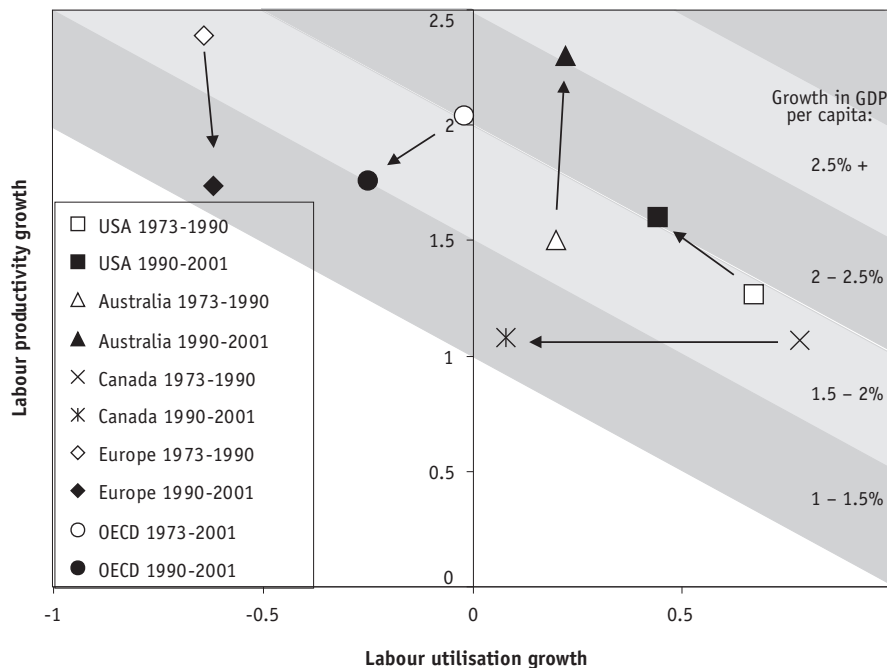
Average annual rates of growth (per cent)



1 Productivity cycles are the intervals between productivity peaks, as identified by the Australian Bureau of Statistics. Labour input is measured as hours worked. No allowance is made for shifts in skill composition. Capital input is measured as capital services.

Data source: Australian Bureau of Statistics (ABS) 5204.0 and unpublished ABS data.

**Chart 2**  
**Contributions to Growth in Per Capita GDP, 1973-1990 and 1990-2001**  
 (Per cent per year)



Data source: Same as Table 1.

labour productivity growth. With the rate of capital deepening stable, higher MFP growth — a 1.1 percentage point acceleration — accounted for all of the acceleration in labour productivity growth.

The surge was also strong by international standards. For the first time, Australia's rate of labour productivity growth exceeded the OECD average (Table 2). In fact, Australia recorded one of the highest productivity accelerations in the OECD area (Gust and Marquez 2000, OECD 2001a).

The productivity surge, in combination with continued growth in labour utilization, fuelled strong growth in average incomes. Australia's GDP per capita ranking climbed to 7th in 2001 (Table 1). By then, Australia also came remarkably close to parity with Canada on average income, productivity and labour utilization.

Chart 2 illustrates the changes in growth in productivity, labour utilization and average income in various countries and country groupings. Productivity growth (vertical axis), plus growth in labour utilization (horizontal axis), equals growth in average income, so that changes in the depth of shade in the diagram represent intervals in growth in average income. Growth rates over 1973-1990 and 1990-2001 are compared.

The chart shows how Australia's acceleration in productivity growth in the 1990s translated directly into strong income growth. The United States also enjoyed an uplift in average income growth, but it was not as strong. Europe and the OECD generally experienced a decline in average income growth, principally because of slower productivity growth. Whilst Canada maintained its productivity growth, average income growth declined with slower growth in labour utilization.

### An Industry Perspective

A new set of service industries contributed to Australia's 1990s productivity surge (Table 3).<sup>6</sup> The stand-out performer was wholesale trade. It

**Table 3**  
**MFP Growth<sup>1</sup> in Selected Industries Over the Last Two Aggregate Productivity Cycles**  
Average annual rates of growth (per cent)

	1988-89 to 1993-94	1993-94 to 1999-2000	Acceleration	Contribution <sup>2</sup>
<b>1990s detractors</b>				
Agriculture	4.2	3.4	-0.8	-0.1
Mining	2.3	2.2	-0.1	-0.0
Manufacturing	2.0	0.9	-1.1	-0.5
Electricity, gas & water	4.0	1.6	-2.3	-0.2
Communication services	6.1	4.0	-2.2	-0.2
Cultural & recreational services	-2.4	-3.7	-1.3	-0.1
<b>1990s contributors</b>				
Construction	-0.5	1.1	1.6	0.3
Wholesale trade	-2.0	5.2	7.3	1.2
Retail trade	0.7	1.1	0.4	0.1
Accommodation, cafes & restaurants	-1.9	0.3	2.2	0.2
Transport & storage	0.8	1.8	0.9	0.2
Finance & insurance	0.1	1.2	1.1	0.2

1 Industry MFP is measured as the ratio of an index of value added to an index of combined inputs of labour and capital.

2 The contribution figures are percentage point contributions to the acceleration in aggregate productivity growth. Contributions are the industry accelerations multiplied by the industry share in aggregate value added.

Source: Productivity Commission estimates.

went from negative measured MFP growth in the previous aggregate productivity cycle (1988-89 to 1993-94) to over 5 per cent annual growth over the 1990s cycle (1993-94 to 1999-2000). MFP also accelerated in other service industries — for example, construction and finance and insurance.

The “traditional” contributors to aggregate productivity growth — agriculture, mining, and manufacturing — did not contribute to the acceleration. Whilst still strong (except for manufacturing), productivity growth in each of these sectors decelerated in the 1990s cycle. Two other strong performers from the 1980s<sup>7</sup> — communication services and electricity, gas and water — also failed to contribute to the surge.

At first, the productivity acceleration in some of the service industries, particularly wholesale trade, seemed surprising and unrelated to policy reform. Closer examination, however, revealed the importance of some reform-related mechanisms, as is explained in the next section.

### **The Influence of Policy Reforms and Other Factors**

Formal analysis of the influence of policy reforms on aggregate productivity growth is not straightforward. Capturing the implementation of reform and specifying an appropriate lag structure to allow for adjustment in production structures are particularly difficult.<sup>8</sup> Reforms were not introduced seamlessly or overnight. Implementation has been drawn out, with variations in pace, over 15-20 years. There has been a mixture of industry-specific measures, introduced at different times, and more general measures, many of which were implemented in phases. Some reforms have been interdependent.

Even so, Salgado (2000) found a positive link at the aggregate level. Support has also come from the elimination of other possible explanations, including the absence of a worldwide productivity boom and recovery from the early 1990s recession (for example, Dowrick 2000). Analysis of particular measures, such as reductions in trade barriers and government business enterprise reforms, and case studies of particular firms and industries have also shown strong positive links (for example, Productivity Commission, 1999). A review of proximate determinants of productivity growth found increased trade orientation, increased specialization (including increased intra-industry trade) and increased adoption of advanced technologies and a higher rate of innovation, stimulated by policy reforms (Productivity Commission, 1999).

Three broad factors have been particularly important:

- sharper competition — through lower trade and foreign investment barriers and domestic deregulation and pro-competition regulation — has provided greater incentives for businesses to improve productivity by seeking out more value-adding products and new markets and by reducing costs;
- greater openness to trade, investment and technology has encouraged greater specialization and has provided easier access to up-to-date technology and know-how; and
- greater flexibility for businesses to adjust production and distribution processes, particularly through a newly-established ability to negotiate work arrangements at the enterprise level, rather than relying on arrangements imposed through centralised “one-size-fits-all” bargaining.

Australia’s efficiency gains have predominantly come from restructuring and modernising production. This is consistent with the view that Australia has embarked on a much-delayed process of catch-up, rather than found some technological breakthrough(s) as a source of rapid productivity growth.

### **ICTs and Productivity Growth**

A strong and rapid uptake of information and communication technologies (ICTs) has been part of Australia’s “modernization”. In previous decades, Australian businesses tended to be technological laggards, except in trade-exposed parts of agriculture and mining. It seems that, in the transition to a more competitive open and flexible economy in the 1990s, Australian businesses found more imperative in taking up the opportunities that technology and innovation provide and found greater flexibility to use ICTs and other technologies to advantage. There was very

little in the way of policy strategy to encourage ICT uptake.

Australia produces comparatively little ICT equipment and software, ruling out advances in production technology as a source of aggregate productivity gains. But Australia has become a major user of ICTs. The growth of investment in ICTs has been especially strong in the 1990s, when investment in hardware grew by 35 per cent a year and software investment grew by 20 per cent a year in real terms.<sup>9</sup> The proportion of Australia's business investment devoted to ICTs ranked 3rd in 1999 among OECD countries (OECD 2001b).

Chart 3 shows that the year-to-year ICT capital deepening contribution to labour productivity growth has been quite similar in the United States and Australia from the mid-1980s. Both had a takeoff from 1995.

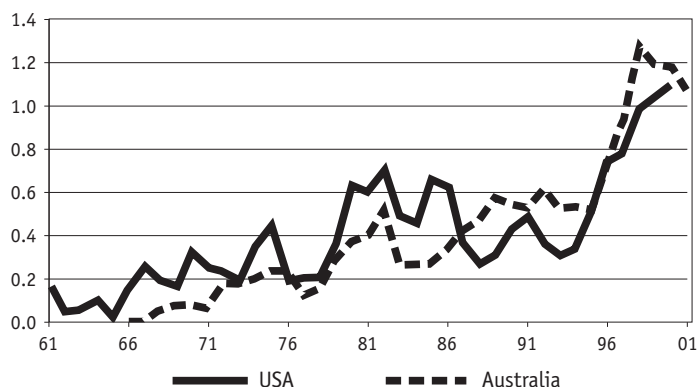
With similar uptake of ICTs in the two countries, the United States can then be used as a benchmark to assess the extent to which Australia's productivity gains can be associated with ICTs. Furthermore, it seems reasonable to assume, consistent with the US leadership in productivity and ICTs, that US estimates establish the upper limit on productivity accelerations that can be associated specifically with ICT production and use.

Table 4 accounts for labour productivity growth over the last two peak-to-peak productivity cycles in the United States and Australia. This introduces a difference between countries in time periods compared (see notes to Table 4), but it ensures that changes in *underlying* rates of productivity growth are compared.<sup>10</sup>

There are several similarities in the US and Australian results:

- ICTs have made strong capital deepening contributions to acceleration in labour productivity in both countries. The contribution is of a similar order of magnitude (around 0.3 to 0.4 of a percentage point) in both cases.

**Chart 3**  
**Contributions of ICT Capital Deepening to Labour Productivity Growth in the United States and Australia, 1961 to 2001**  
(Per cent)



Source: PC estimates based on unpublished ABS data and BLS data.

**Table 4**  
**Contributions to Labour Productivity Accelerations in the 1990s Cycle in the United States and Australia**  
Per cent per year

	US <sup>1</sup>	Australia <sup>2</sup>
Labour productivity growth	0.5	1.0
Capital deepening	0.2	-0.1
- ICT capital	0.3	0.4
- Other capital	-0.2	-0.5
MFP contribution <sup>3</sup>	0.3	1.1

1 Growth in 1992 to 2000 less growth in 1986 to 1992.

2 Growth in 1993-94 to 1999-00 less growth in 1988-89 to 1993-94.

3 MFP growth for the US includes the contribution to labour productivity growth from labour quality.

Source: Updated from Parham, Roberts and Sun (2001).

- However, much or all of the increased use of ICTs in the 1990s has been offset by slower growth in the use of other forms of capital. There has been little or no increase in the overall rate of capital deepening in either country, especially in Australia (Table 4). This contrasts with the various studies of the US, which have found that ICTs have contributed to a marked increase in the rate of substitution of capital for labour.

- Faster MFP growth accounts for most of the 1990s labour productivity accelerations in both countries, and entirely so in Australia.

Assuming that no other factor has generated a productivity *acceleration*, the US estimates in Table 4 set the upper limit on ICT-related gains. Some of the 0.3 of a percentage point MFP acceleration must be attributed to *production* of ICTs. Studies, such as Oliner and Sichel (2000), have attributed around 0.3 of a percentage point of aggregate MFP growth to ICT production, although the acceleration was calculated pre- and post-1995; and this may not represent a change in trend.<sup>11</sup> The acceleration over productivity cycles could be less — perhaps half.

This leaves a contribution of perhaps 1 or 2 tenths of a percentage point from ICT use to the acceleration in underlying aggregate MFP growth in the United States. Even if the more favourable pre- and post-1995 figures are used, the most that can be attributed to ICT use is 0.3 of a percentage point.<sup>12</sup>

Applying this US benchmark to the Australian case (which requires the further assumption that any differences in industry mix in the two countries do not affect their aggregate productivity accelerations) suggests that use of ICTs has contributed at most 0.3 of a percentage point and non-ICT factors have contributed the bulk (0.8 of a percentage point or more) to the acceleration in Australia's multifactor productivity growth.

An examination of industry estimates for both the United States and Australia suggests that the ICT-productivity links are strongest in distribution, financial intermediation and business services. These industries are more intensive ICT users and have shown stronger productivity accelerations in both countries.

The Australian evidence is consistent with the view advanced, for example, by Bresnahan, Brynjolfson and Hitt (2002) that it is the innovations in products and processes, enabled by ICT

use, that generate the productivity gains. The finance and insurance industry has been restructured to operate much more through ICTs (for example, ATMs, internet and phone banking) than through traditional face-to-face contacts. Many new products (for example, financial derivatives) are now on offer. Australian banks, in particular, have been able to support strong growth in output, with quite major reductions in numbers of branches and employees.

A study by Productivity Commission staff (Johnston et al, 2000) also found that ICTs played a part in the restructuring of wholesaling activities. Businesses were able to use bar-code and scanning technology and inventory management systems as part of the process of transforming wholesaling from a storage-based to a fast flow-through operation that reduces storage and handling.

But, importantly, reforms were acting as the underlying drivers and facilitators of productivity gains and ICTs were just one component of change. It was not so much that wholesaling became much more ICT intensive or that new breakthrough technologies became available. It was more that the competitive incentives to be productive became stronger and that new flexibilities became open to businesses to use ICTs as part of a more general process of restructuring and transformation.

For example, the motor vehicle industry was looking for efficiencies all along the value chain — and not just in production — to meet the increased competition from cheaper imports entering under lower border protection. The domestic industry has restructured its distribution and customer/production links. Another contributor in some areas was the reform of industrial relations processes that allowed greater labour flexibility through the introduction of split shifts and reduced the rigidity of job demarcations between different occupational groups.



The importance of competition as a driver is also indicated by the distribution of the productivity gains. Despite very large productivity gains in wholesaling, the gross rate of profit actually *declined* (Parham et al, 2000).

One policy debate in Australia has centred on whether Australia needs to be a producer of ICTs in order to access “new economy” productivity gains. The evidence suggests that production is not necessary and, indeed, its wisdom could be questioned on comparative advantage grounds. Australia has tapped productivity gains by becoming a “smart” user. Furthermore, by relying mostly on imports of ICT hardware and software, Australia has enjoyed a sizeable terms of trade gain from the rapid declines in ICT prices.<sup>13</sup>

## Education and Skills

Increased skills in the workforce are likely to have also played a role in Australia’s productivity improvement, although the magnitude of the role is yet to be established. Secondary school retention rates and tertiary participation have increased, particularly amongst females over the past three decades.

Increased skills can influence productivity growth in two ways. First, skills can directly raise the productivity of workers. Second, in line with endogenous growth theory, a more educated and experienced workforce can promote the uptake and further development of advanced technologies. Relatively high skills in the Australian workforce, for example, are likely to have played a part in the rapid uptake of ICTs (Barnes and Kennard 2002).

Education and skills do not appear to have influenced Australia’s productivity resurgence by the first, direct route. According to experimental Australian Bureau of Statistics data, the employment of skills increased more rapidly in the

1980s than in the 1990s, meaning that there was not an acceleration in skills to match the 1990s productivity acceleration. Skill composition detracted from, rather than contributed to, 1990s productivity growth (Barnes and Kennard 2002). However, the influence on the rates of absorption of technology and innovation remains a possibility that warrants further investigation. Dowrick (2002) has laid an important path with a review and interpretation of the theoretical and empirical literature.

## Concluding Remarks

Australia’s economic performance since the early 1990s has been remarkable in both historical and international terms. GDP growth has averaged just under 4 per cent a year, seemingly unperturbed by major external shocks.

A surge in productivity growth has underpinned Australia’s strong performance. Both labour and multifactor productivity growth climbed to record highs.

Policy reforms have been major drivers and enablers. Reforms have enhanced competitive pressures; opened the economy to trade, investment and technology; and allowed greater flexibility to adjust all aspects of production, distribution and marketing.

Changes have been long in the making. Momentum for implementation of reforms came from a growing sense of crisis in the 1980s about Australia’s growth in living standards. It was recognised that previous policies had locked in structural weaknesses in the economy, which meant that Australia was not well placed to meet the challenges of stronger international competition, rapid technological change and closer global integration. Reforms have been comprehensive, but have been implemented gradually and in a sequence that reflects some degree of pragmatism. More still remains to be done.

In broad terms, reforms have released the shackles on the economy and have both forced it and allowed it to modernise. Australia has enjoyed rapid productivity growth while it has embarked on much-delayed catch-up — a process that many other advanced countries undertook in earlier decades.

Perhaps fortuitously, Australia's modernization came at the right time for businesses to take advantage of the ICT revolution. Restructuring also seems to be taking on board the innovations in products and processes that ICTs facilitate.

The catch-up view of Australia's productivity surge suggests that the rate of productivity will slow as the ready and obvious changes shorten in supply. On the other hand, the ICT experience suggests that permanent and dynamic growth-enhancing forces are at work and that the economy is not just in transition to a new higher level of productivity.

Canada and Australia have always been considered similar on a number of grounds — colonial background, institutions, geographical sparseness and regional concentrations of population. Our closeness on productivity and living standards is remarkable, provides ready comparators for the future and begs to be better understood.

## Notes

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- 1 GDP per capita in 2001 was \$25,923 in Canada and \$25,818 in Australia, measured in 1996 \$US at purchasing power parity. GDP per hour worked was respectively \$30.53 and \$30.32. Estimates are from the source cited in Table 1.
- 2 Korea is not included in the 22 countries in Tables 1 and 2.
- 3 For a listing of major microeconomic reforms, see Industry Commission (1998).

- 4 Data drawn from the Australian Bureau of Statistics sources refers to financial years. The financial year ending June 30, 1991, for example, is referred to as 1990-91.
- 5 The market sector covers roughly two-thirds of the measured economy, but excludes government administration, health, education and other areas for which output cannot be satisfactorily measured for productivity analysis.
- 6 Some caution about the precision of the industry productivity estimates is appropriate. The estimates reported here are based on a value-added output measure and capital and labour inputs, rather than a gross output measure and KLEMS inputs.
- 7 The improved performance in these two sectors in the 1980s, stemmed from the major reform-induced efficiencies (e.g. better investment decisions and reductions in excess manning) achieved in government enterprises, as well as technological advances in some activities.
- 8 Adjustment packages, involving government-funded incentives for investment, export and innovation have been offered to some industries, but not others. Some employees have also been offered various forms of adjustment assistance.
- 9 The Australian volume estimates of ICTs are based on hedonic price deflators, drawn from a US hardware price deflator (adjusted by a lag and exchange rate movements) and an assumed reduction in software prices of 6 per cent a year.
- 10 Studies of the United States have typically compared productivity growth and ICT contributions before and after the 1995 takeoff. These studies therefore identify the maximum contributions of ICTs to productivity growth. But 1995 was a trough year in US labour productivity, so that estimates from 1995 to the peak at the end of the 1990s overstate the underlying rate of labour productivity growth. Further, estimates of the productivity acceleration are sensitive to period selection (Parham, Roberts and Sun, 2001). Use of peak-to-peak productivity cycles provides defense against both these issues. Productivity peaks in the United States were identified as turning points above trend (Parham, Roberts and Sun, 2001).
- 11 See note 10. Also some of the decline in ICT prices was due to increased competition and was not entirely due to productivity increases (Aizcorbe, 2002).
- 12 Comparing the first and second halves of the 1990s produces an acceleration in labour productivity of 0.6 percentage points of annual growth. Taking the contribution of ICT production to be the Oliner and Sichel figure of 0.3 of a percentage point, leaves 0.3 of a percentage point to be attributed to ICT use (Parham 2002).
- 13 ICT prices have fallen by 9.5 per cent per year in domestic currency terms between 1985 and 2001 and have raised the terms of trade by 0.3 per cent a year. Since 1995, ICT prices have fallen by nearly 15 per cent a year, raising the terms of trade by 0.75 per cent a year (Treasury 2002).

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